1. (Original) An apparatus comprising:

at least one processor;

a memory coupled to the at least one processor;

a first instruction stream residing in the memory; and

a profile-based loop optimizer residing in the memory and executed by the at least one processor, the loop optimizer inserting instrumentation code into the first instruction stream that collects profile data in at least one execution frequency table and thereby generating a second instruction stream, each execution frequency table indicating values representative of the number of times a corresponding loop is executed each time the loop is entered.

2. (Original) The apparatus of claim 1 wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value when the second instruction stream is executed.

3. (Original) The apparatus of claim 1 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel at least one loop in the first instruction stream.

4. (Original) The apparatus of claim 1 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to unroll at least one loop in the first instruction stream.

5. (Original) The apparatus of claim 1 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel and unroll at least one loop in the first instruction stream.

6. (Original) The apparatus of claim 1 wherein the instrumentation code comprises:

code to allocate a loop iteration counter for a selected loop;

code to allocate the execution frequency table for the selected loop;

code to clear the loop iteration counter on all entry paths to the selected loop;

code to increment the loop iteration counter in a header block for the selected loop; and

code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop.

7. (Original) An apparatus comprising:

at least one processor;

a memory coupled to the at least one processor;

a first instruction stream residing in the memory; and

a profile-based loop optimizer residing in the memory and executed by the at least one processor, the loop optimizer optimizing at least one loop in the first instruction stream according to profile data stored in at least one execution frequency table, each execution frequency table indicating values representative of the number of times a corresponding loop is executed each time the loop is entered.

8. (Original) The apparatus of claim 7 wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value when the first instruction stream is executed.

9. (Original) The apparatus of claim 7 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel at least one loop in the first instruction stream.

10. (Currently amended) The apparatus of claim 9 wherein the profile-based loop optimizer peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

11. (Currently amended) The apparatus of claim 10 wherein the profile-based loop optimizer unrolls the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.

12. (Original) The apparatus of claim 7 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to unroll at least one loop in the first instruction stream.

13. (Original) The apparatus of claim 7 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel and unroll at least one loop in the first instruction stream.

14. (Original) The apparatus of claim 7 wherein the profile-based loop optimizer determines whether to peel or unroll a loop based on a dominant mode, if present, in the execution frequency table corresponding to the loop.

15. (Original) An apparatus comprising:

(A) at least one processor;

(B) a memory coupled to the at least one processor;

(C) a first instruction stream residing in the memory; and

(D) a profile-based loop optimizer residing in the memory and executed by the at least one processor, the loop optimizer inserting instrumentation code into the first instruction stream that collects profile data in at least one execution frequency table and thereby generating a second instruction stream, wherein each execution frequency table includes a plurality of entries, each entry containing:

(D1) a value representative of the number of times a loop is executed each time the loop is entered; and

(D2) a count of the occurrences of each value when the second instruction stream is executed;

(E) wherein the instrumentation code comprises:

(E1) code to allocate a loop iteration counter for a selected loop;

(E2) code to allocate the execution frequency table for the selected loop;

(E3) code to clear the loop iteration counter on all entry paths to the selected loop;

(E4) code to increment the loop iteration counter in a header block for the selected loop; and

(E5) code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop;

(F) the loop optimizer optimizing a loop in the first instruction stream according to profile data stored in the at least one execution frequency table by peeling the loop, unrolling the loop, or both peeling and unrolling the loop based on profile data stored in the execution frequency table corresponding to the loop.

16. (Currently amended) The apparatus of claim 15 wherein the profile-based loop optimizer peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

17. (Currently amended) The apparatus of claim 16 wherein the profile-based loop optimizer unrolls the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.

18. (Original) A method for instrumenting a first instruction stream comprising the steps of:

inserting code into the first instruction stream for a selected loop that defines at least one execution frequency table for the selected loop, each execution frequency table indicating values representative of the number of times the selected loop is executed each time the selected loop is entered;

inserting code into the first instruction stream that updates the execution frequency table according to the number of times the selected loop is executed each time the loop is entered.

19. (Original) A method for instrumenting a first instruction stream comprising the steps of:

inserting code that allocates a loop iteration counter for a selected loop in the first instruction stream;

inserting code that allocates an execution frequency table that corresponds to the selected loop; and

inserting code to clear the loop iteration counter on all entry paths to the selected loop;

inserting code to increment the loop iteration counter in a header block for the selected loop; and

inserting code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop according to the number of times the selected loop is executed each time the loop is entered.

20. (Original) A method for optimizing at least one loop in a first instruction stream, the method comprising the steps of:

inserting instrumentation code into the first instruction stream that collects profile data in at least one execution frequency table and thereby generating a second instruction stream, each execution frequency table indicating values representative of the number of times a corresponding loop is executed each time the loop is entered; and

optimizing at least one loop in the first instruction stream according to profile data stored in at least one execution frequency table.

21. (Original) The method of claim 20 wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value when the first instruction stream is executed.

22. (Original) The method of claim 20 further comprising the step of using values in the at least one execution frequency table to peel at least one loop in the first instruction stream.

23. (Currently amended) The method of claim 20 wherein the step of using values in the at least one execution frequency table to peel at least one loop in the first instruction stream peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

24. (Currently amended) The method of claim 23 further comprising the step of unrolling the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.

25. (Original) The method of claim 20 further comprising the step of using values in the at least one execution frequency table to unroll at least one loop in the first instruction stream.

26. (Original) The method of claim 20 further comprising the step of using values in the at least one execution frequency table to peel and unroll at least one loop in the first instruction stream.

27. (Original) The method of claim 20 further comprising the step of determining whether to peel or unroll a loop based on a dominant mode, if present, in the execution frequency table corresponding to the loop.

28. (Original) A method for optimizing a plurality of loops in a first instruction stream, the method comprising the steps of:

(A) inserting code that allocates a loop iteration counter for at least one loop in the first instruction stream;

(B) inserting code that allocates an execution frequency table that corresponds to a loop in the first instruction stream, wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value;

(C) inserting code to clear the loop iteration counter on all entry paths to the selected loop;

(D) inserting code to increment the loop iteration counter in a header block for the selected loop; and

(E) inserting code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop according to the number of times the selected loop is executed each time the loop is entered;

(F) the inserting code in steps (A) through (E) generating a second instruction stream;

(G) executing the second instruction stream with sample inputs to collect profile data in the at least one execution frequency table;

(H) using values in the at least one execution frequency table to peel at least one loop in the first instruction stream based on profile data stored in the execution frequency table corresponding to the loop; and

(claim 28 continued)

(I) using values in the at least one execution frequency table to unroll at least one loop in the first instruction stream based profile data stored in the execution frequency table corresponding to the loop.

29. (Currently amended) The method of claim 28 wherein the step of using values in the at least one execution frequency table to peel at least one loop in the first instruction stream peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

30. (Currently amended) The method of claim 29 wherein the step of using values in the at least one execution frequency table to unroll at least one loop in the first instruction stream unrolls the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.

31. (Original) A program product comprising:

(A) a profile-based loop optimizer that inserts instrumentation code into a first instruction stream that collects profile data in at least one execution frequency table and thereby generates a second instruction stream, each execution frequency table indicating values representative of the number of times a corresponding loop is executed each time the loop is entered; and

(B) computer-readable signal bearing media bearing the profile-based loop optimizer.

32. (Original) The program product of claim 31 wherein the computer-readable signal bearing media comprises recordable media.

33. (Original) The program product of claim 31 wherein the computer-readable signal bearing media comprises transmission media.

34. (Original) The program product of claim 31 wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value when the second instruction stream is executed.

35. (Original) The program product of claim 31 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel at least one loop in the first instruction stream.

36. (Original) The program product of claim 31 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to unroll at least one loop in the first instruction stream.

37. (Original) The program product of claim 31 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel and unroll at least one loop in the first instruction stream.

38. (Original) The program product of claim 31 wherein the instrumentation code comprises:

code to allocate a loop iteration counter for a selected loop;

code to allocate the execution frequency table for the selected loop;

code to clear the loop iteration counter on all entry paths to the selected loop;

code to increment the loop iteration counter in a header block for the selected loop; and

code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop.

39. (Original) A program product comprising:

(A) a profile-based loop optimizer that optimizes at least one loop in a first instruction stream according to profile data stored in at least one execution frequency table, each execution frequency table indicating values representative of the number of times a corresponding loop is executed each time the loop is entered; and

(B) computer-readable signal bearing media bearing the profile-based loop optimizer.

40. (Original) The program product of claim 39 wherein the computer-readable signal bearing media comprises recordable media.

41. (Original) The program product of claim 39 wherein the computer-readable signal bearing media comprises transmission media.

42. (Original) The program product of claim 39 wherein each execution frequency table includes a plurality of entries, each entry containing:

(1) a value representative of the number of times a loop is executed each time the loop is entered; and

(2) a count of the occurrences of each value when the first instruction stream is executed.

43. (Original) The program product of claim 39 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel at least one loop in the first instruction stream.

44. (Currently amended) The program product of claim 39 wherein the profile-based loop optimizer peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

45. (Currently amended) The program product of claim 44 wherein the profile-based loop optimizer unrolls the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.

46. (Original) The program product of claim 39 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to unroll at least one loop in the first instruction stream.

47. (Original) The program product of claim 39 wherein the profile-based loop optimizer uses values in the at least one execution frequency table to peel and unroll at least one loop in the first instruction stream.

48. (Original) The program product of claim 39 wherein the profile-based loop optimizer determines whether to peel or unroll a loop based on a dominant mode, if present, in the execution frequency table corresponding to the loop.

49. (Original) A program product comprising:

(A) a profile-based loop optimizer that inserts instrumentation code into a first instruction stream that collects profile data in at least one execution frequency table and thereby generating a second instruction stream, wherein each execution frequency table includes a plurality of entries, each entry containing:

a value representative of the number of times a loop is executed each time the loop is entered; and

a count of the occurrences of each value when the second instruction stream is executed;

wherein the instrumentation code comprises:

code to allocate a loop iteration counter for a selected loop;

code to allocate the execution frequency table for the selected loop;

code to clear the loop iteration counter on all entry paths to the selected loop;

code to increment the loop iteration counter in a header block for the selected loop; and

code to read the loop iteration counter and update the execution frequency table along all exit paths from the selected loop;

the loop optimizer optimizing a loop in the first instruction stream according to profile data stored in the at least one execution frequency table by peeling the loop, unrolling the loop, or both peeling and unrolling the loop based on profile data stored in the execution frequency table corresponding to the loop; and

(B) computer-readable signal bearing media bearing the profile-based loop optimizer.

50. (Original) The program product of claim 49 wherein the computer-readable signal bearing media comprises recordable media.

51. (Original) The program product of claim 49 wherein the computer-readable signal bearing media comprises transmission media.

52. (Currently amended) The program product of claim 49 wherein the profile-based loop optimizer peels a selected loop if one of the following conditions are true:

(A) the execution frequency table for the selected loop has a dominant mode that is less than a specified peeling threshold;

(B) the execution frequency table for the selected loop does not have a dominant mode, and [most of the execution frequencies] a majority of the values in the execution frequency table are smaller than the specified peeling threshold.

53. (Currently amended) The program product of claim 52 wherein the profile-based loop optimizer unrolls the selected loop if:

neither (A) nor (B) are true; and

[most of the execution frequencies] a majority of the values in the execution frequency table for the selected loop are greater than a specified unrolling threshold.